

## Improved hinge for electronic device

### FIELD OF THE INVENTION

5 [001] The present invention relates generally to portable electronic devices.

### BACKGROUND OF THE INVENTION

[002] Figure 1 shows a typical laptop computer 100. Laptop computer 100 has a base portion 101, which comprises a keyboard 106, a central processing unit, and 10 often data storage devices. A display portion 102 typically comprises a display screen 105. The base portion and the display portion are connected by one or more hinges 103. The display portion can be thought of as rotating about axis 104 of the hinge to open or close the laptop computer. Figure 1 shows the computer in the open configuration. In the closed configuration, display screen 105 and keyboard 106 are 15 in close proximity, and the computer is substantially rectangular in shape. A laptop computer often contains at least one battery that enables the computer to be operated for a period of time without a connection to any power source external to the computer.

[003] The portability of a computer such as laptop computer 100 is an advantage to 20 computer users who wish to be mobile, enabling them to work in remote locations such as job sites, automobiles, and airplanes. However, a remote location may not be configured for convenient use of laptop computer 100. Figure 2 depicts laptop computer 100 in position for use by a person seated in airline seat 201. Laptop computer 100 is placed on tray table 202 affixed to airline seat 203. With laptop 25 computer 100 in its open configuration, display portion 102 encounters the back of seat 203 at location 204, necessitating that laptop computer 100 be moved toward the user, thus further limiting the already cramped space that the computer user, seated in

seat 201, has for comfortably operating the computer. Other kinds of electronic devices, such as Digital Versatile Disc (DVD) viewers, personal digital assistants (PDAs), or dedicated word processors may suffer from the same difficulty.

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## SUMMARY OF THE INVENTION

[004] A movable portion of an electronic device is attached to a base portion of the device by a hinge mechanism that enables an edge of the movable portion to translate as the movable portion is rotated during the opening of the portable electronic device. In one example embodiment, the hinge mechanism comprises a groove in the base 10 portion, a guiding feature on the moveable portion that engages the groove, and a link attached to both the base portion and the moveable portion of the electronic device, the link relating the motions of the two portions such that the electronic device opens as the guiding feature travels along the groove.

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## BRIEF DESCRIPTION OF THE DRAWINGS

[005] Figure 1 shows a shows a typical laptop computer.

[006] Figure 2 depicts the laptop computer of Figure 1 in position for use by a person seated in an airline seat.

20 [007] Figure 3 shows a laptop computer in accordance with an example embodiment of the invention.

[008] Figure 4 shows a partially exploded and partially cutaway view of the example laptop computer of Figure 3.

25 [009] Figures 4A and 4B show enlarged views of a portion of the example laptop computer of Figure 3.

[0010] Figures 5A - 5E schematically show partially cutaway views of the example laptop computer of Figure 3 in progressive stages of opening.

#### DETAILED DESCRIPTION

5 [0011] Figure 3 shows a laptop portable computer 300 in accordance with an example embodiment of the invention. Base portion 301 and movable display portion 302 of portable computer 300 are connected through a hinge mechanism 305 such that when the computer is in its open configuration, edge 303 of display portion 302, the edge that is nearest base portion 301, is displaced from edge 304 of base portion 301. The  
10 following figures detail the workings of example hinge mechanism 305 that accomplishes this motion. Example laptop computer 300 incorporates two instances of hinge mechanism 305, in mirror image. Like reference numerals indicate the same parts in the figures.

[0012] Figure 4 shows a partially exploded and partly cutaway view of computer 300.  
15 In Figure 4, display portion 302 has been displaced so that more of hinge mechanism 305 is exposed for viewing and explanation. Figures 4A and 4B are magnified views of the area indicated in Figure 4. Figure 4B is shown from a reverse angle.

[0013] Referring now to both Figures 4A and 4B, shaft 402 is journaled in depending member 403 of display portion 302 of example laptop computer 300. Distal end 404 of shaft 402 protrudes such that when display portion 302 is fully assembled to base portion 301, engages groove 405 in base portion 301. Distal end 404 thus provides a guiding feature that provides a constraint on the relative motion of base portion 301 and display portion 302. Groove 405 may be formed into base portion 301 by any of a number of methods. For example, it may be molded into base portion 301, or it may  
20 be formed as a cutout in a sheet metal insert in base portion 301. One of skill in the  
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art will recognize other ways to form the elements of hinge mechanism 305. Groove 405 has a centerline 407 equidistant from the two generally parallel sides of the groove.

[0014] Link 408 provides another constraint on the relative motion of base portion 301 and display portion 302. Rear end 409 of link 408 attaches to base portion 301 at pivot 410. Pivot 410 may be a shoulder screw, a stud, or another element providing an equivalent function. Forward end 411 of link 408 attaches to display portion 302 at pivot 412, which is displaced in Figures 4, 4A, and 4B because the views are partially exploded. Link 408 is substantially rigid, and constrains base portion 301 and display portion 302 such that pivot 410 is a constant distance from pivot 412.

[0015] When example laptop computer 300 is closed, guiding feature 404 rests near rear end 413 of groove 405. As example laptop computer 300 is opened, guiding feature 404 travels along groove 405 toward forward end 414. In the process, link 408 constrains the relative positions of base portion 301 and display portion 302 such that the opening angle between them is a prescribed function of the position of guiding feature 404 in groove 405. During opening, depending portion 403 of display portion 302 sweeps through cavity 415 in base portion 301.

[0016] Figures 5A - 5E schematically show partially cutaway views of example laptop computer 300 in progressive stages of opening, from fully closed in Figure 5A to nearly fully open in Figure 5E. Some features of example laptop computer 300 have been omitted from these views for clarity in showing the action of hinge mechanism 305.

[0017] A user of example laptop computer 300 may wish to open the computer to a preferred viewing angle, and have display portion 302 stay in this preferred relationship to base portion 301 while still being adjustable with moderate effort.

Hinge mechanism 305 may comprise a friction-inducing device for facilitating this ability. Referring again to Figures 4A and 4B, gear 401 is fixedly attached to shaft 402. Also formed in base portion 301 is curved gear rack 406. Gear rack 406 has a pitch line (not shown) that is a substantially uniform distance from centerline 407 of groove 405. A pitch line is a theoretical line along which the pitch of a gear is measured. Gear 401 engages and travels along gear rack 406 when distal end 404 of shaft 402 travels along groove 405.

5 [0018] Gear 401 is fixedly attached to shaft 402 so that shaft 402 rotates as gear 401 travels along gear rack 406. Spring 416 wraps around shaft 402, exerting light 10 compressing force on shaft 402. Spring 416 comprises at least one tail portion 417. Cavity 418 in display portion 302 is sufficiently large to contain spring 416, and is generally cylindrical but for one flattened side 419. Flattened side 419 prevents the rotation of spring 416 within cavity 418. Because shaft 402 rotates and spring 416 cannot, friction is induced that resists the rotation of shaft 402, holding screen portion 15 302 in a position set by the computer user. Spring 416 is thus part of a wrap spring friction clutch. The dimensions of spring 416 and shaft 402 are chosen such that the friction is sufficient to hold screen portion 302 in position, but to still enable the easy adjustment of screen portion 302.

20 [0019] Other friction-inducing devices could be used within the scope of the appended claims. For example, shaft 402 could be a three-lobed shaft that rotates in a compliant, generally-cylindrical collar attached to display portion 302. Alternatively, depending portion 403 of display portion 302 could contact a wall of cavity 415 on base portion 301 so that the sweeping motion of depending portion 403 is resisted by the friction between the two parts. An intermediate material could be chosen to 25 provide the appropriate coefficient of friction.

[0020] While the invention has been described by way of example as embodied in a laptop computer, it may be embodied in other electronic devices as well. For example, a personal digital assistant (PDA) is a portable electronic device that enables a user to carry data and perform some computing applications, such as maintaining an 5 appointment calendar and address book. Many PDAs comprise a base portion and a moveable display portion. The invention may be embodied in a PDA. Other kinds of electronic devices that may open and close in a similar fashion and could embody the invention comprise dedicated word processors, and dedicated viewers for Digital Versatile Discs (DVDs). A dedicated word processor may contain many of the 10 components of a computer, but lack the general configurability of a computer, but instead be configured to enable a user to compose, edit, and print documents. A viewer for DVDs typically comprises a base portion comprising a mechanism that can read data from a DVD, and a display portion on which the contents of the DVD are displayed. Such viewers are often portable, and may be used to watch movies or 15 other entertainment programming.